

**RTCA Special Committee 186, Working Group 3**

**ADS-B 1090 MOPS, Revision A**

**Meeting 7**

**Appendix Material for 1090 TIS Broadcast**

**Draft 4**

**Presented by Vincent Orlando**

**SUMMARY**

**This working paper proposes the fourth draft of TIS-B material for Appendix A. It includes comments received at meeting #6 of WG-3, as well as comments received from the SCRPS Technical Subgroup. The text that is changed are identified by a strike through and underlines**

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## A.2 Traffic Information Service – Broadcast (TIS-B) Formats and Coding

### A.2.1 Introduction

**Notes:**

1. *This section of Appendix A defines the formats and coding for a Traffic Information Service Broadcast (TIS-B) based on the same 112-bit 1090 MHz signal transmission that is used for ADS-B on 1090 MHz.*
2. *TIS-B complements the operation of ADS-B by providing ground-to-air broadcast of surveillance data on aircraft that are not equipped for 1090 MHz ADS-B. The basis for this ground surveillance data may be an ATC Mode S radar, a surface or approach multilateration system or a multisensor data processing system. The TIS-B ground-to-air transmissions use the same signal formats as 1090 MHz ADS-B and can therefore be accepted by a 1090 MHz ADS-B receiver.*
3. *TIS-B service is the means for providing a complete surveillance picture to 1090 MHz ADS-B users during a transition period. After transition, it also provides a means to cope with a user that has lost its 1090 MHz ADS-B capability.*

### A.2.2 TIS-B Format Definition

TIS-B information is broadcast using the 112-bit Mode S DF=18 format as shown below in Figure A-13:



**Figure A-13: TIS-B Format Definition**

### A.2.3 Control Field Allocation

The content of the DF=18 transmission is defined by the value of the control field, as specified in Table A-21.

**Table A-21: “CF” Field Code Definitions in DF=18 ADS-B and TIS-B Messages.**

CF Value	ICAO/Mode A Flag (IMF)	Meaning
0	N/A	ADS-B message from a non-transponder device, AA field holds 24-bit ICAO aircraft address
1	N/A	Reserved for ADS-B message in which the AA field holds anonymous address or ground vehicle address or fixed obstruction address
2	0	Fine TIS-B message, AA field contains the 24-bit ICAO aircraft address
	1	Fine TIS-B message, AA field contains the 12-bit Mode A code followed by a 12-bit track file number
3	0	Coarse TIS-B airborne position and velocity message, AA field contains the 24-bit ICAO aircraft address
	1	Coarse TIS-B airborne position and velocity message, AA field contains the 12-bit Mode A code followed by a 12-bit track file number.
4	N/A	Reserved for TIS-B management message AA field holds TIS-B service volume ID + other information (e.g., MSB of reference position for the service volume)
5 – 7	N/A	Reserved for other uses (e.g., for FIS-B messages)

**A.2.4 TIS-B Surveillance Message Definition**

**A.2.4.1 TIS-B Fine Airborne Position Message**

The TIS-B fine airborne position ME field shall be formatted as specified in Figure A-14.

***Note:** Additional details are specified in the following paragraphs.*

**A.2.4.1.1 ICAO/Mode A Flag (IMF)**

This one-bit field (bit 8) shall indicate the type of identity associated with the aircraft data reported in the TIS-B message. IMF equal to ZERO (0) shall indicate that the TIS-B data is identified by an ICAO 24-bit address. IMF equal to ONE (1) shall indicate that the TIS-B data is identified by a “Mode A” code. A “Mode A” code of all zeroes shall indicate a primary radar target.

***Note:** The AA field is coded differently for 24-bit addresses and Mode A codes as specified in Table A-21.*

#### **A.2.4.1.2 Pressure Altitude**

This 12-bit field shall provide the aircraft pressure altitude. This field shall contain barometric altitude encoded in 25 or 100-foot increments (as indicated by the Q Bit). All zeroes in this field shall indicate that there is no altitude data.

#### **A.2.4.1.3 Compact Position Reporting (CPR) Format (F)**

This field shall be set as specified in subparagraph A.1.4.2.1

#### **A.2.4.1.4 Latitude/Longitude**

The latitude/longitude fields in the TIS-B fine airborne position message shall be set as specified in subparagraph A.1.4.2.3.

#### **A.2.4.2 TIS-B Surface Position Message**

The TIS-B surface position ME field shall be formatted as specified in Figure A-15.

*Note: Additional details are specified in the following paragraphs.*

##### **A.2.4.2.1 Movement**

This field shall be set as specified in subparagraph A.1.4.3.1

##### **A.2.4.2.1.1 Ground Track (true)**

##### **A.2.4.2.1.1.1 Ground Track Status**

This field shall be set as specified in subparagraph A.1.4.3.2.1.

##### **A.2.4.2.1.1.2 Ground Track Angle**

This field shall be set as specified in subparagraph A.1.4.3.2.2.

##### **A.2.4.2.12 ICAO/Mode A Flag (IMF)**

This one-bit field (bit 21) shall indicate the type of identity associated with the aircraft data reported in the TIS-B message. IMF equal to ZERO (0) shall indicate that the TIS-B data is identified by an ICAO 24-bit address. IMF equal to ONE (1) shall indicate that the TIS-B data is identified by a “Mode A” code. A “Mode A” code of all zeroes shall indicate a primary radar target.

*Note: The AA field is coded differently for 24-bit addresses and Mode A codes as specified in Table A-21.*

##### **A.2.4.2.1.3 Compact Position Reporting (CPR) Format (F)**

This field shall be set as specified in subparagraph A.1.4.3.3.

#### **A.2.4.2.1.4 Latitude/Longitude**

The latitude/longitude fields in the TIS-B fine surface position message shall be set as specified in subparagraph A.1.4.3.5.

#### **A.2.4.3 Identification and Category Message**

The TIS-B identification and category ME field shall be formatted as specified in Figure A-16. This message shall only be used for aircraft identified with an ICAO 24-bit address.

*Note: Additional details are specified in the following paragraphs.*

#### **A.2.4.3.1 Aircraft Identification Coding**

This field shall be set as specified in subparagraph A.1.4.4.1.

#### **A.2.4.4 Airborne Velocity Message**

The TIS-B airborne velocity ME field shall be formatted as specified in the Figure A-17.

*Note: Additional details are specified in the following paragraphs.*

#### **A.2.4.4.1 Subtype Field**

Only subtypes 1 and 2 shall be used for the TIS-B airborne velocity message. Subtype 1 shall be used for velocities under 1000 knots and subtype 2 shall be used for aircraft capable of supersonic flight when the velocity might exceed 1022 knots.

The supersonic version of the velocity coding shall be used if either the east-west OR north-south velocities exceed 1022 kt. A switch to the normal velocity coding shall be made if both the east-west AND north-south velocities drop below 1000 kt.

#### **A.2.4.4.2 ICAO/Mode A Flag (IMF)**

This one-bit field (bit 9) shall indicate the type of identity associated with the aircraft data reported in the TIS-B message. IMF equal to ZERO (0) shall indicate that the TIS-B data is identified by an ICAO 24-bit address. IMF equal to ONE (1) shall indicate that the TIS-B data is identified by a "Mode A" code. A "Mode A" code of all zeroes shall indicate a primary radar target.

*Note: The AA field is coded differently for 24-bit addresses and Mode A codes as specified in Table A-21.*

#### **A.2.4.4.3 Magnetic Heading in Airborne Velocity Messages**

#### **A.2.4.4.3.1 Magnetic Heading Status**

This field shall be set as specified in subparagraph A.1.4.5.5.1.

**A.2.4.4.3.2 Magnetic Heading Value**

This field shall be set as specified in subparagraph A.1.5.5.1.

**A.2.4.5 Coarse Airborne Position Message**

The TIS-B coarse airborne position ME field shall be formatted as specified in Figure A-18.

**Notes:**

1. *This message is used if the surveillance source for TIS-B is not of high enough quality to justify the use of the fine formats. An example of such a source is a scanning beam Mode S interrogator.*
2. *Additional details are specified in the following paragraphs.*

**A.2.4.5.1 ICAO/Mode A Flag (IMF)**

This one-bit field (bit 1) shall indicate the type of identity associated with the aircraft data reported in the TIS-B message. IMF equal to ZERO (0) shall indicate that the TIS-B data is identified by an ICAO 24-bit address. IMF equal to ONE (1) shall indicate that the TIS-B data is identified by a “Mode A” code. A “Mode A” code of all zeroes shall indicate a primary radar target.

**Note:** *The AA field is coded differently for 24-bit addresses and Mode A codes as specified in Table A-21.*

**A.2.4.5.2 Service Volume ID (SVID)**

The 4-bit SVID field shall identify the TIS-B site that delivered the surveillance data.

**Note:** *In the case where TIS-B messages are being received from more than one TIS-B ground stations, the SVID can be used to select coarse messages from a single source. This will prevent the TIS-B track from wandering due to the different error biases associated with different sources.*

**A.2.4.5.3 Pressure Altitude**

This 12-bit field shall provide the aircraft pressure altitude. This field shall contain barometric altitude encoded in 25 or 100-foot increments (as indicated by the Q Bit).

**A.2.4.5.4 Latitude/Longitude**

The latitude/longitude fields in the TIS-B coarse airborne position message shall be set as specified in subparagraph A.1.4.2.3, except that the 12-bit form of CPR coding shall be used.

**A.2.5 TIS-B Management Messages**

**Note:** *TIS-B management messages announce the location and the service volume of the TIS-B ground station. This information aids in the selection of a ground site by an airborne TIS-B user. The management message is also used as a "keep alive" indication to alert a user when service becomes unavailable. .*

**A.2.5.1 TIS-B Management Message Content**

**TBD**

**Figure A-14: TIS-B Fine Airborne Position Message**

1	
2	
3	FORMAT TYPE CODE
4	(See A.1.4.1 and Note 1)
5	
6	SURVEILLANCE STATUS
7	LSB
8	IMF (See A.2.4.1.1)
9	
10	
11	PRESSURE ALTITUDE
12	
13	
14	The altitude code (AC) as specified
15	in section 2.2.13.1.2 of DO-181B but
16	with the M-bit removed
17	
18	
19	
20	
21	Reserved
22	CPR FORMAT (F) (See A.1.4.2.1)
23	MSB
24	
25	
26	
27	
28	
29	
30	CPR ENCODED LATITUDE
31	
32	(CPR Airborne Format
33	See A.1.7.1 to A.1.7.5)
34	
35	
36	
37	
38	
39	LSB
40	MSB
41	
42	
43	
44	
45	
46	
47	CPR ENCODED LONGITUDE
48	
49	(CPR Airborne Format
50	See A.1.7.1 to A.1.7.4)
51	
52	
53	
54	
55	
56	LSB

**Purpose:** To provide airborne position information for aircraft that are not equipped with 1090 MHz ADS-B when the TIS-B service is based on high quality surveillance data.

**Surveillance Status** coding

- 0 = no condition information
- 1 = permanent alert (emergency condition)
- 2 = temporary alert (change in Mode A identity code other than emergency condition)
- 3 = SPI condition

Codes 1 and 2 take precedence over code 3.

**Figure A-15: TIS-B Fine Surface Position Message**

1	
2	
3	FORMAT TYPE CODE
4	(See A.1.4.1)
5	
6	
7	
8	
9	MOVEMENT
10	(See A.1.4.3.1)
11	
12	
13	STATUS for Gnd Tk (1 =valid, 0 = not valid)
14	MSB
15	
16	GROUND TRACK (7 bits)
17	(See A.1.4.3.2)
18	
19	<b>Resolution = 360/128 deg</b>
20	LSB
21	IMF (See A.2.4.2.12)
22	CPR FORMAT (F) (See A.1.4.2.1)
23	MSB
24	
25	
26	
27	
28	
29	
30	CPR ENCODED LATITUDE
31	
32	(CPR Surface Format See A.1.7.1 to A.1.7.4 and A.1.7.6)
33	
34	
35	
36	
37	
38	
39	LSB
40	MSB
41	
42	
43	
44	
45	
46	
47	CPR ENCODED LONGITUDE
48	
49	(CPR Surface Format See A.1.7.1 to A.1.7.4)
50	
51	
52	
53	
54	
55	
56	LSB

**Purpose:** To provide surface position information for aircraft that are not equipped with 1090 MHz ADS-B.

**Figure A-16: TIS-B Identification and Category Message**

1	
2	
3	FORMAT TYPE CODE
4	(See A.1.4.1)
5	
6	
7	EMITTER CATEGORY
8	
9	MSB
10	
11	CHARACTER 1
12	
13	
14	LSB
15	MSB
16	
17	
18	CHARACTER 2
19	
20	LSB
21	MSB
22	
23	CHARACTER 3
24	
25	
26	LSB
27	MSB
28	
29	CHARACTER 4
30	
31	
32	LSB
33	MSB
34	
35	CHARACTER 5
36	
37	
38	LSB
39	MSB
40	
41	
42	CHARACTER 6
43	
44	LSB
45	MSB
46	
47	CHARACTER 7
48	
49	
50	LSB
51	MSB
52	
53	CHARACTER 8
54	
55	
56	LSB

**Purpose:** To provide aircraft identification and category for aircraft that are not equipped with 1090 MHz ADS-B.

**Type coding:**

- 1 = Aircraft identification, category set D
- 2 = Aircraft identification, category set C
- 3 = Aircraft identification, category set B
- 4 = Aircraft identification, category set A

**ADS-B Emitter Category coding:**

Set A

- 0 = No ADS-B Emitter Category Information
- 1 = Light (< 15 500 lbs.)
- 2 = Small (15 500 to 75 000 lbs.)
- 3 = Large (75 000 to 300 000 lbs.)
- 4 = High Vortex Large (aircraft such as B-757)
- 5 = Heavy (> 300 000 lbs.)
- 6 = High Performance (> 5 g acceleration and > 400kts)
- 7 = Rotorcraft

Set B

- 0 = No ADS-B Emitter Category Information
- 1 = Glider/sailplane
- 2 = Lighter-than-Air
- 3 = Parachutist/Skydiver
- 4 = Ultralight/hang-glider/paraglider
- 5 = Reserved
- 6 = Unmanned Aerial Vehicle
- 7 = Space/Trans-atmospheric Vehicle

Set C

- 0 = No ADS-B Emitter Category Information
- 1 = Surface Vehicle – Emergency Vehicle
- 2 = Surface Vehicle – Service Vehicle
- 3 = Fixed Ground or Tethered Obstruction
- 4-7 = Reserved

Set D : Reserved

**Aircraft identification coding:**

Coding as specified for A.1.4.4

**Figure A-17: TIS-B Airborne Velocity Messages  
(Subtypes 1 and 2: Velocity Over Ground)**

BDS 0,9

1	MSB	1
2		0
3	FORMAT TYPE CODE = 19	0
4		1
5	LSB	1
6	SUBTYPE 1 0	SUBTYPE 2 0
7	0	1
8	1	0
9	IMF (See A.2.4.4.2)	
10	Reserved	
11		
12		
13		
14	DIRECTION BIT for E-W velocity (0=East, 1=West)	
15	EAST-WEST VELOCITY (10 bits)	
16	NORMAL : LSB = 1 knot	SUPERSONIC : LSB =4 knots
17	All zeros = no velocity info	All zeros = no velocity info
18	<u>Value</u> <u>Velocity</u>	<u>Value</u> <u>Velocity</u>
19	1              0 kts	1              0 kt
20	2              1 kt	2              4 kt
21	3              2 kt	3              8 kt
22	-              -	-              -
23	1022          1021 kt	1022          4084 kt
24	1023          >1021.5 kt	1023          > 4086kt
25	DIRECTION BIT for N-S velocity (0=North, 1=South)	
26	NORTH-SOUTH VELOCITY (10 bits)	
27	NORMAL : LSB = 1 knot	SUPERSONIC : LSB =4 knots
28	All zeros = no velocity info	All zeros = no velocity info
29	<u>Value</u> <u>Velocity</u>	<u>Value</u> <u>Velocity</u>
30	1              0 kts	1              0 kt
31	2              1 kt	2              4 kt
32	3              2 kt	3              8 kt
33	-              -	-              -
34	1022          1021 kt	1022          4084 kt
35	1023          >1021.5 kt	1023          > 4086kt
36	Reserved	
37	SIGN BIT FOR VERTICAL RATE: 0 = up, 1 = down	
38	VERTICAL RATE (9 bits)	
39	All zeros – no vertical rate information, LSB = 64 ft/min	
40	<u>Value</u>	<u>Vertical rate</u>
41	1	0 ft/min
42	2	64 ft/min
43	-	-
44	510	32576 ft/min
45	511	> 32608 ft/min
46		
47	Reserved	
48		
49		
50		
51		
52		
53		
54		
55		
56		

**Purpose:** To provide velocity information for aircraft that are not equipped with 1090 MHz ADS-B when the TIS-B service is based on high quality surveillance data.

**Subtype Coding**

Code	Velocity	Type
1	Ground speed	normal
2		supersonic

**Figure A-18: TIS-B Coarse Airborne Position Message**

1	<b>IMF</b> (See A.2.4.5.1)
2	<b>SURVEILLANCE STATUS</b>
3	
4	MSB
5	<b>SERVICE VOLUME ID (SVID)</b>
6	
7	LSB
8	MSB
9	
10	
11	
12	
13	<b>PRESSURE ALTITUDE</b>
14	
15	
16	
17	
18	
19	LSB
20	<b>GRND TRACK STATUS</b> (1=valid, 0=invalid)
21	<b>GROUND TRACK ANGLE</b> MSB (180°)
22	(90°)
23	(45°)
24	(22.5°)
25	LSB (11.25°)
26	<b>GROUND SPEED</b> MSB (1024 knots)
27	(512 knots)
28	(256 knots)
29	(128 knots)
30	(64 knots)
31	LSB (32 knots)
32	<b>CPR FORMAT (F)</b> (0 = even, 1 = odd)
33	
34	
35	
36	
37	
38	<b>CPR-ENCODED LATITUDE</b>
39	
40	(CPR Airborne Format
41	See A.1.7.1 to A.1.7.5)
42	
43	
44	LSB
45	MSB
46	
47	
48	
49	
50	<b>CPR-ENCODED LONGITUDE</b>
51	
52	(CPR Airborne Format
53	See A.1.7.1 to A.1.7.4)
54	
55	
56	LSB

**Purpose:** To provide airborne position information for aircraft that are not equipped with 1090 MHz ADS-B when the TIS-B service is based on moderate quality surveillance data..

**Figure A-19: TIS-B Management**

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**Purpose:** To provide information about the location and the service volume boundaries of the TIS-B ground station

